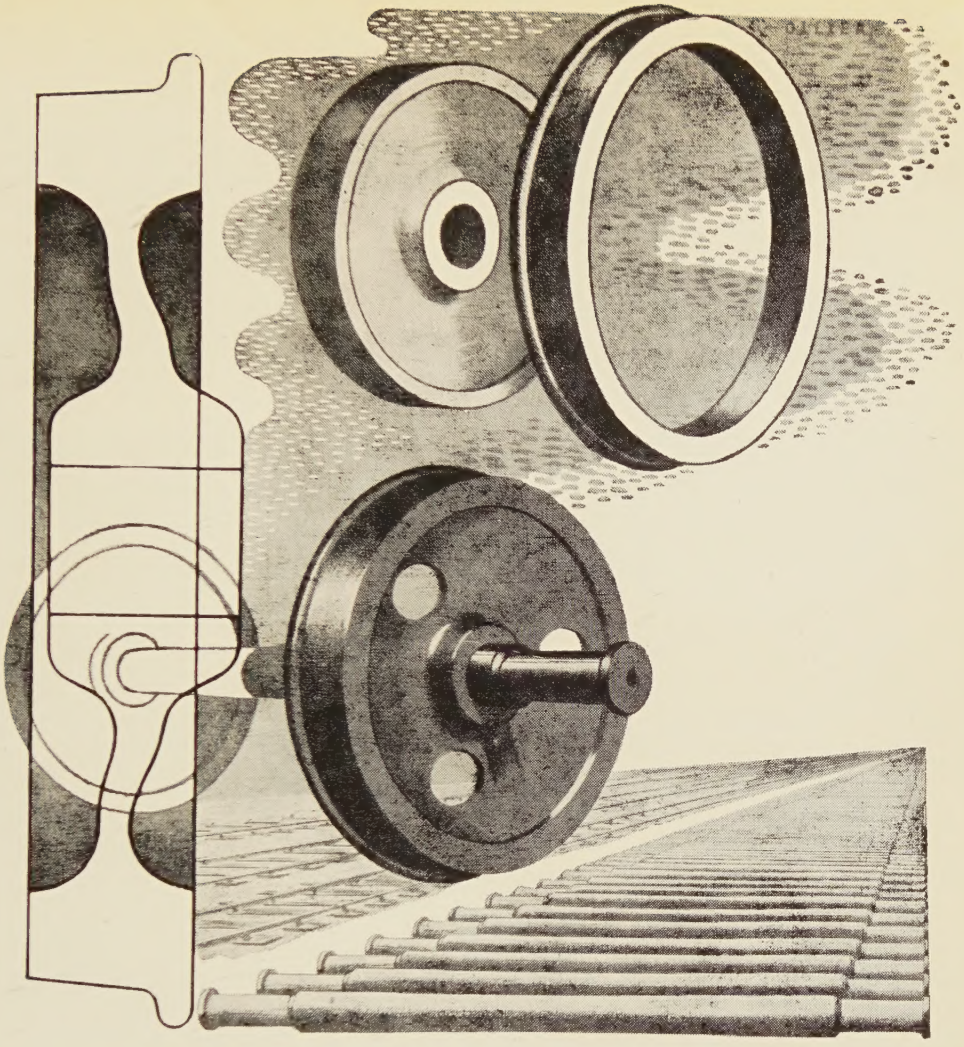
VOL. XXIX. — No. 6. JUNE 1952.

# Monthly Bulletin of the International Railway Congress Association

(English Edition)





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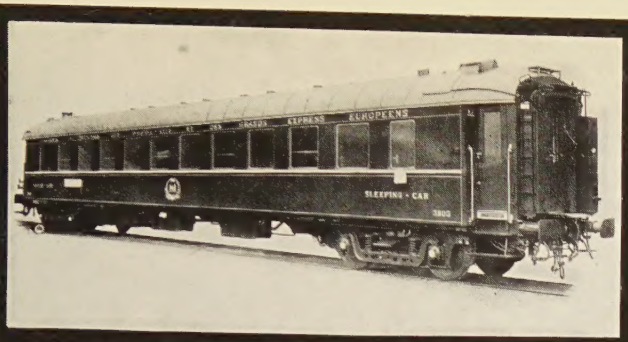


Sleeping-car
of the Compagnie Internationale
des Wagons-Lits.

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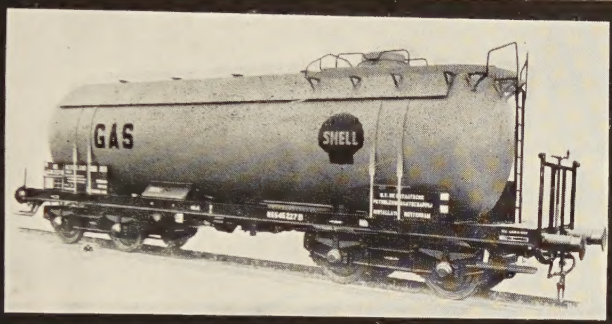
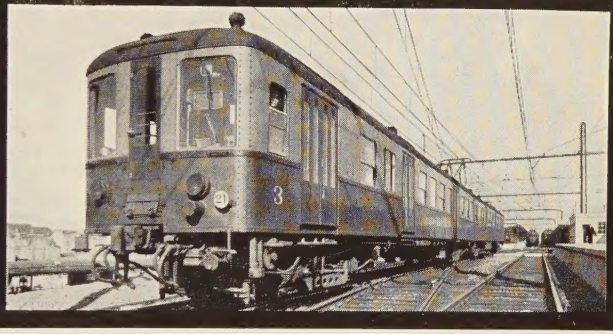
for transport of propane.



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# Alphabetical Index of Advertisers

Bulletin de l'Association internationale du Congrès des Chemins de fer

SOMMAIRE DU NUMÉRO DE JUIN 1952.

# MONTHLY BULLETIN

OF THE

# INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(ENGLISH EDITION)

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Vol. XXIX. — No. 6. June 1952.

BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

# SPECIAL ACCOUNTS

summing up the reports on the questions for discussion at the Enlarged Meeting of the Permanent Commission. (Stockholm, 1952.)

# SECTION I. — Way and works.

[ 625 .162 & 656 .254 ]

## QUESTION I.

A. — What are the new safety measures taken for level crossing of railway tracks by the road in respect of the density, high tonnage and speed of the road traffic?

In particular automatic signalling and closing of level crossings without keepers, worked by the trains themselves.

Technical and statistical investigation in order to ascertain the relative safety of :

1° level crossings with keepers, with the different devices to announce the arrival of the train to the keepers;

2° level crossings without keepers :

a) without any self-acting device announcing the arrival of trains;

b) with automatic signalling for the road-users;

c) with automatic signalling completed by half- or entire gates.

B — Cases of level crossing of railway tracks by a road with a railway (urban or suburban) running alongside.

## SPECIAL REPORT,

by A. DONIZEAU,
Chef du Service de la Voie et des Bâtiments de la Région Ouest de la Société Nationale des Chemins de fer français.

The present report sums up the reports by Messrs G. MATTHEWS and S. WILLIAMS for :

America (North and South), Australia (Commonwealth of), Burma, China, Ceylon, Egypt, India, Irak, Iran, Irish Free State, New Zealand, Pakistan, South Africa, Sudan, United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible. (See *Bulletin* for March 1952, p. 177.)

on the one hand,

and that by M. A. DONIZEAU for :

Austria, Belgium and Colony, Bulgaria, Czechoslovakia, Denmark, Finland, France and Overseas Territories, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Norway, Poland, Portugal and Colonies, Rumania, Spain, Sweden, Switzerland, Syria, Turkey and Yugoslavia. (See *Bulletin* for May 1952, p. 343.)

on the other,

as well as the supplement to M. DONIZEAU's Report for :

Austria (part), Portugal and her Colonies (Mozambique Railways) and Czechoslovakia. (See *Bulletin* for June 1952, p. 529.)

## CHAPTER I.

## GENERAL.

### Considerations regarding the risks at level crossings.

The question of safety at level crossings has become more and more serious since the end of the first world war, owing to the considerable modifications, which have occurred in the character of the road traffic. These modifications, already reported at the Cairo Congress, are due to the development of motor vehicles and have led to :

— a considerable increase in the number of motor vehicles which by increasing the road traffic at level crossings has greatly increased the risks of accidents;

— the constant increase in the speed of road vehicles, very marked from the very beginnings of motor traffic compared with the old horse-drawn traffic, but which tends to increase still more year by year as the engines and design of the vehicles are perfected;

— in certain cases a very important change in the ratio between the masses between road traffic and railway traffic. Here the very considerable increase in the size of heavy goods vehicles has added very greatly to the possible consequences of collision with trains, with a risk of derailment for the latter, especially as the railway at the same time has considerably lightened some of its traffic (railcars);

— the fact that some road traffic, which did not exist in previous times, is particularly dangerous when coming into collision with other vehicles. We refer to the tankers carrying liquid fuels.

Regarding the railway traffic, it appears that the modifications that have occurred during the same period have, especially in certain countries, frequently increased the safety : a reduction in the speed and number of services on secondary lines, suppression of passenger trains. It does not appear that the number of trains on the main lines has often been increased; if the average speeds have sometimes been increased, this only affects a relatively few trains.

The serious modifications occurring in the character of the road traffic have led the railways and the authorities watching over them to examine the problem of level crossings very closely in order to introduce the improved installations needed by these new conditions.

The importance of the financial aspect of the problem is obvious. It is absolutely unjust that the railway, which has had to suffer and has not provoked the modifications made to the original conditions, should have to bear the whole of expense entailed by such modifications. On the other hand, the very amplitude of the problem makes it essential to look for economical solutions and that unnecessary equipment be avoided. As a matter of informa-

tion, the number of persons killed yearly is as follows in some European countries :

| | |
|---|---|
| *Austria* . . . | 12 (not including pedestrian crossings). |
| *Belgium* . . | 20-30, do. |
| *France* . . . | 40-60, do. |
| *Great Britain* . | 40, including pedestrian and private crossings. |
| *Holland* . . | 30, not including pedestrian crossings. |
| *Portugal* . . | 10, do. |
| *Sweden* . . . | 30, do. |
| *Switzerland* . | 20, do. |

Undoubtedly the U. S. A. are exceptional in having some thousand people killed every year in accidents at level crossings involving motor vehicles. This is undoubtedly due to the very great development of motor traffic in the U. S. A. compared with Europe. These statistics show both the present extent of the problem, and what it might be should motor traffic increase.

The conclusion to be drawn is that, if level crossings must be equipped in order to increase safety, it is necessary, as financial resources are far from being illimitable, to equip them with discernment, i. e. adapt the financial effort to the safety requirements of the different categories of level crossings, grading the equipment according to the risk.

A priori, any argument that a monetary value can be given to a fatal accident to arrive at a decision as to the amount of money to be invested to prevent such an accident happening, may shock those who have not come up against this problem. However, it is impossible to avoid such an argument. No installation will give 100 % safety, i. e. probable risk nil, and it is obvious, to give an example, that it is perfectly reasonable to make economies at a small level crossing where there is very little risk in order to have more to spend on improving the equipment at a more dangerous level crossing.

These considerations have led to the idea, on the one hand, of giving a numerical value to the relative risk at different level crossings or different categories of level crossings, and on the other hand, of grading the different systems of operating level crossings, even endeavouring to express in figures the relative risks occurring with the different systems. In the first case, the product of the average daily number of road vehicles multiplied by the number of trains has been used by some Administrations. It does not appear that they intended this figure to be the true expression of the probability of collisions occurring, even in the case of a level crossing by itself, i. e. without keeper nor equipment. Many other factors come into play however, such as the visibility, the angle of crossing, the slope, whether the peak traffic period do or do not coincide, the character and the speed of the road and railway traffics, etc. However, such a figure gives some idea, a very rough one it is true, but usable if for example it is used to fix the limits which, at the first approximation, decide the study of the equipment under consideration. It appears, in addition, reasonable to try and find a better expression. Studies of this sort have been undertaken by the Swedish State Railways, though they gave no details in their reply.

As regards the grading of the equipment, it is doubtless possible to imagine it for a given level crossing, but the setting up of a grading system of this sort cannot be taken as valid for all the level crossings, certain equipment giving results independent of the factors which, on the contrary, are the chief reasons for deciding on other systems of working. (Example : two level crossings, one of which has good visibility, the other poor visibility, all other characteristics being equal, are very much the same if they are operated with keepers on the open system with a good method of automatic warning, whereas the position is very different if they are operated with keepers on the closed system without automatic warning.)

These conditions drive us to conclude that the results of the statistics of accidents at level crossings, classed according to the

different ways they are equipped, cannot be used unless with the greatest prudence.

This does not prevent us, however, from trying to come to some conclusion by consulting the statistics, and it would certainly be extremely valuable if uniform statistics, the exact bearing of which was carefully studied to begin with, were prepared by all the Administrations.

## CHAPTER II.

### Résumé of existing practices.

### Tendencies of the different Administrations.

There are a certain number of questions on which the Administrations consulted have very similar of not identical tendencies.

These are as follows :

1) *Signalling the existence of a level crossing to road users.*

The international Protocol of Geneva codified these signals, with the result that road users making international journeys are greatly assisted in all the countries, who observe this protocol;

2) *Improving the visibility of the gates when closed at level crossings with keepers.*

The use of suitable colours, luminous paint and catseyes have solved this problem very suitably;

3) *Improving the types of gates.*

Apart from the British Railways, which use hinged gates which can shut off either the road or the railway lines (as decreed by the laws), most Administrations agree in recognising the value of relatively light gates turning around a horizontal axis, which can be moved very quickly (so-called oscillating gates).

As regards the method of operating level crossings, from reading the reports it appears that, with the exception of the U. S. A. most railways employ keepers. However, very generally, for reasons of economy, level crossings where there is little road traffic, on secondary lines, and where the visibility is sufficiently good, have no keepers but are merely marked by a white and red St. Andrews Cross, preceded, at the designed distance, by the regular signal for level crossings without keepers (locomotive on a triangle). In addition, a certain number of countries, following the example of the U. S. A., are favouring the system of having no keepers but giving automatic warning of the approach of trains. Certain Administrations have already equipped a fair number of level crossings in this way

The Swedish State Railways are in the van with 1 058 level crossings (out of about 2 000 without keepers without signals and about 3 000 with keepers). Then come, with a varying number of such crossings, the Deutsche Bundesbahn, the S. N. C. B., the Danish State, the South African Rys., the Norwegian State, the Netherlands Railways, the Swiss Federal Railways. Finally, other Administrations such as the S. N. C. F. in particular, are definitely proceeding along these lines.

Private level crossings, which do not seem to be much of a problem for most of the Administrations consulted, are on the contrary a serious matter for the British Railways, which have 22 000 such crossings, some of which have almost become public level crossings. The situation of these level crossings was explained in the report by Messrs. G. MATTHEWS and S. WILLIAMS. It is a fact that the situation of private level crossings has become a more serious matter nearly everywhere owing to the fact that the agricultural traffic using them has in recent years increased very considerably in size and weight, so that the risk to the railway has increased. These circumstances explain the value of the precautions taken by a certain number of Administrations when heavy or exceptional traffic is going to use such crossings, requiring the user to obtain an authorisation to use the crossing from the railway, so that appropriate safety measures can be taken.

Finally, question 1 B — Level crossings where an urban or suburban railway line runs alongside the road — does not appear to raise any special difficulties, except in certain countries. It appears that if the trains on the suburban railway do not run on sight, such a case is dealt with like the crossing of two railway lines, i. e. covered by interlocking signals for the converging routes. If on the contrary, the suburban line in question has the character of a tramway, i. e. the trains approaching the level crossing are running on sight, the level crossing is dealt with like an ordinary level crossing with a keeper, and is sometimes protected on the railway side by signals. In certain cases, derailing points have been installed on the secondary line to protect the level crossing when closed to road traffic. There are a few very rare cases of level crossings run over by tramways, which have no keepers and are equipped with automatic signals. It does not appear that any special arrangements have been made in such cases.

Pedestrian crossings, whether attached to level crossings for vehicles, or crossings solely for pedestrians, usually are crossed at the risk and peril of those using them, without any special arrangements, and it appears that this system can be retained. It should be noted however that the South African Railways appear to have keepers at certain pedestrian crossings, the gates sometimes being replaced by a turnstile which can be locked at a given moment in such a way that a pedestrian on the crossing can get out, but no one can get onto the crossing.

Before coming to the suggested summaries, we will sum up below the details given in the reports about public level crossings for vehicles, which apart from the special case of the British Railways, is the essential part of the question.

### Level crossings with keepers.

The present position regarding level crossings with keepers, compared with what it was at the time of the Cairo Congress in 1933, seems to have evolved on rather different lines according to the country concerned. In most countries, this evolution was considerably upset by the second world war. However, it may be, whether progress had already been made before the second world war, or whether is has been made since, the position as regards these level crossings seems to have evolved fairly favourably in many countries. Apart from the efforts with which we have already dealt, concerning the methods by which the road users are warned of the presence of a level crossing and when the gates are closed, the improvements made have had the object above all of improving the methods of keeping the keepers advised. The information given differs considerably, from the regular timetable with special trains being advised by the preceding train, to the bells and signs of the automatic warning, with all the intermediate methods such as bells operated by hand, by a push-button, telephone, bells and other means of communication. The automatic warning has been very much developed by some Administrations, the S. N. C. F. in particular, and to a slightly lesser degree the Deutsche Bundesbahn and Swedish State. Other Administrations have gone in more for manual warnings.

The ways in which such automatic warnings are given by means of track circuits or pedals and the ways of cancelling the warning (manual cancellation, automatic cancellation) are described in the reports. It appears from these that though there is no absolute unanimity regarding the details of such equipment, the automatic warning is a method of keeping the keeper informed which has now been proved. It has been possible to design installations in which nearly every possible failure can be turned into a premature warning, and it is no exaggeration to say that an automatic warning installation equipped with all the improvements that can now be made at a reasonable cost, is one of the most certain ways of protecting level crossings with

heavy railway and road traffics operated on the open system.

Protection by means of signals, if necessary interlocked with the gates, is also used by a certain number of Administrations. It appears that this is frequently done on the British Railways who appear to like this method, and did not express any reservations regarding it. The S. N. C. B. sees in it a valuable solution from the point of view of safety; they stress however the drawbacks of this system as regards the piling up of the road traffic when this is heavy.

It appears, in fact, on analysis that this system is not as attractive as it seems at first sight; on the one hand, it can only be considered absolutely safe when the interlocking of the gates and signals is completed by interlocking of the approach; on the other hand, the necessity to advise the keeper of the approach of a train in good time so that the train will not find the distant signal at danger, in the case of slow trains running on lines which are also used by fast trains, will lead to the level crossing being closed too long to suit the road traffic. Finally, the multiplicity of signals involved should this method be extended makes the driver's job very difficult. All these reasons explain why protection by signals is not more generally used.

Questions of lesser importance, such as the control of level crossings from a distance, the problem of trains running in the wrong direction, do not appear to give rise to any great difficulties.

**Level crossings without keepers without warning of the approach of trains.**

The Administrations are practically unanimous in agreeing that this system can be used in the case of roads with little or average traffic crossing lines whose traffic is likewise little or average, provided certain conditions as regards visibility are met. The traffic on the road and on the line are expressed by some Administrations in the form of the traffic moment; although, as we have seen, this idea of the traffic moment cannot be considered as giving, to a sufficient degree, a relative idea of the risk, it is convenient to use it at any rate to define the limit above which the system with which we are now dealing will not be considered in the first stages. First of all, it is essential that the level crossing without keeper cannot be mistaken by the road user for a level crossing with keeper : the distant road signal (locomotive on a triangle) and the signal by the crossing (St. Andrews Cross with red and white bands) as given in the Geneva Protocol solve this question. We will see later on however that the question of a distinction between the distant signal given road users in the case of a level crossing without keeper by means of a light signal and a level crossing without keeper without a light signal, can be of value if anything goes wrong. Finally, several Administrations have pointed out the special risk in the case of double track lines (road user tempted to cross as soon as the train has passed without bothering about a train coming from the opposite direction). In this connection, we think it advisable to designate systematically double track level crossings by doubling the arms of the St. Andrews Cross, as authorised by the Geneva Protocol moreover.

As regards visibility on the line, there are no uniform regulations. It appears of value to make a distinction, as is done in several cases, between roads on which the traffic is essentially local and there are very few motors, and roads with through traffic. In the former case, it is sufficient if the trains are visible from close quarters. In the latter case, in addition to good visibility near the crossing, the line must be visible from the road for at least the braking distance of motor vehicles, this distance being expressed by formula in terms of the speed at which vehicles approach the crossing, as a speed limit can be imposed.

Many Administrations require trains to whistle on approaching level crossings without keepers; some of them even make use of codified and prolonged whistles. In

certain cases, provision is made for the whistle to be made more powerful. There are sometimes exceptions to these rules in populated districts.

The improvement of the visibility of railcars by day is also under study.

The use of the system without keeper without signals is from all accounts a source of economies, and it is rational to look out for level crossings with keepers at which such an economy can be made.

On the other hand, certain level crossings have been operated without keepers for many years or from the origin of the railway lines, at a time when there were fewer regulations concerning the conditions to be fulfilled than at present, on roads whose character has altered considerably. These may be a grave problem at the present time. Some of them can be made to comply with the regulations by undertaking work to improve visibility or by reducing the road and rail traffic speeds: in other cases, it is not possible to do so. The position of the latter consequently raises both a safety and a financial problem. The question of safety can usually be solved by equipping such level crossings with signals giving warning of the approach of a train. As for who is responsible for the cost thereby incurred, it would obviously not be fair to make the railway responsible, since it is variations in the road traffic that have altered the position of the level crossing.

Safety at level crossings without keepers without signals depending above all on keeping a look out, it is essential that certain kinds of road traffic, such as cattle should be strictly controlled, and that the regulations should be enforced.

**Level crossings without keepers with automatic warning of the approach of the trains.**

Im chapter I, we gave a list of the Administrations which have a fairly considerable number of level crossings without keepers with automatic warning of the approach of the trains. There are quite a number of Administrations who agree in recognising that this system, which on the whole is economical, satisfies safety requirements at even important level crossings under acceptable conditions provided the road users are sufficiently well educated and disciplined.

To the latter conditions must be added, as in the case of level crossings without keepers without signals, the need for having strictly enforced regulations applying to the use of such crossings by cattle.

On the other hand, Messrs Matthews and Williams' Report do not consider such equipment gives adequate protection.

In examining this very important question, it is difficult to formulate any summaries based on reasoning alone, and it is necessary to base any conclusions arrived at on the results already obtained in actual practice.

The U. S. A. statistics appended to Messrs Matthews and Williams' Report show that a very large number of fatal accidents have occurred due to collisions on level crossings. This fact, added to the fact that in the U. S. A. there are a great many level crossings without keepers equipped with automatic signalling seems to support the conclusions arrived at in the above report regarding the effectiveness of such signalling.

On the other hand, Table I of the « accident factors » given in the same report, which seems to grade the installations, by giving the number of accidents per 100 level crossings per annum according to the equipment, taking comparable level crossings, puts automatic signalling with half-gates in the forefront as regards safety, then well up an automatic light signal on a single track line, and only medium, automatic lights at level crossings over multiple tracks with gates in service at times.

Reservations must be made, as we have seen, regarding the value to be placed on attempts to grade the installations at level crossings according to statistics. However,

numerical results, given in Table 1 above mentioned, show by their incidence that it must be admitted that qualitatively at any rate, the grading in question may be applicable to a great many level crossings. In any case, it does not appear that the statistical details for the U. S. A. can logically lead to the condemnation of the system without keepers with automatic signalling.

It appears that in order to get as accurate as possible a picture of the problem, it is necessary to point out that it is the duty of the railway, in the case of public level crossings other than those operating on the system without keepers without signals, to give road users a danger signal, either by means of the gates in the case of level crossings with keepers, or by automatic light signals (with or without gates or half-gates).

In the present state of technical knowledge, which of these two methods gives the greatest safety?

To answer this question, it is interesting to consult the statistics of certain Administrations which have a relatively large number of level crossings with automatic signals.

Sweden is one such case, and here we find from statistics of accidents over 5 years (1946-1950) covering an average of 900 level crossings with automatic signals that there were no accidents due to defects in the equipment, whereas during the same period, in the case of 2 800 level crossings with keepers, all of which moreover were equipped with manual or automatic warning of the approach of trains, mistakes on the part of the staff caused 33 accidents.

In the same way, Belgian statistics covering the same 5 year period show that in the case of 300 level crossings without keepers, equipped with automatic signalling, no accidents were caused by defects in the equipment, whereas during the same period in the case of 2 000 level crossings with keepers all equipped with manual or automatic warning of the approach of trains, i. e. very well equipped, mistakes on the part of the staff caused 28 accidents.

It appears from an examination of these figures, that by doing away with the possibility of human error, the automatic signalling equipment used makes it possible to give the road users a more certain danger indication than is given by the closed gates in the case of crossings with keepers. An exception may be made in the case of crossings with keepers protected by signal interlocked with the gates and with the train signals. We have seen the interference such a system causes to the road traffic and the regularity of the railway services, which seriously limits its use.

The above report requires some comments as regards its consequences. As for level crossing accidents, a distinction can be made between

— the total number of accidents;

— the number of accidents for which the railway is responsible;

— the number of accidents for which road users are responsible;

— and, in each case, the number killed, the latter figure showing the gravity of the accidents in question.

The actual definition of the accidents should be very carefully gone into. Accidents at level crossings with keepers and those at level crossings without keepers are very different in character, those at level crossings with keepers including a great many cases of running into the gates which are not always followed by collisions between road vehicles and railway rolling stock. It is also fairly certain that the statistics supplied were not all prepared in the same way. In this connection, certain Administrations only appear to have counted those cases of running into the gates which had serious consequences, whilst others have included all such cases whatever their consequences.

In the case of accidents at level crossings without keepers, the accidents in question are nearly always collisions.

This explains why the following conclusions can be drawn from the Swedish and Belgian statistics, which are somewhat dif-

ferent, relating to accidents at level crossings without keepers with automatic signals :

*a*) accidents at such level crossings are much fewer in number, but much more serious in their consequences than those occurring at level crossings with keepers. This is the conclusion to be drawn from the Swedish statistics;

*b*) they are more numerous and more serious in their consequences than those occurring at level crossings with keepers. This is the conclusion to be drawn from the Belgian statistics.

Such conclusions however cannot be left as they stand in either case, as it is not possible to reduce the statistical results to comparable values owing to the lack, as we have seen, of any corrective factor showing the other side of the average risk attached to a level crossing under either system. We think, however, it can be stated, in general, that by eliminating possible mistakes on the part of the keeper, the system with keepers with automatic signalling gives the road user a more certain warning of the approach of a train, but if the method (without keepers) is to replace that of having keepers, if the results obtained are to be favourable, the road users must be well educated and disciplined, and it was plain that many of the Administrations consulted were much concerned about this.

The system without keepers with warning of the approach of trains seems to be of the greatest value in the following two cases :

1) *Doing away with the keeper and obtaining economies* at level crossings where there are now keepers and where it appears that reasonable safety can be expected with the new method;

2) *Equipping level crossings without keepers without signals* in cases where changes in the characteristics of the road traffic have made the existing system unsafe, and there is no other more economical solution.

If, on the whole, many Administrations are in agreement with the above points, there is on the other hand much to be done if unanimity is to be obtained on certain questions some of which are of the greatest importance, as we shall see when examining the characteristics of the system without keepers with automatic signalling.

— *Exact meaning of the signal giving warning of the approach of a train.*

The type of signal to be used has been laid down by the Geneva Protocol; one or two red winking lights which can be accompanied by some sound signal. Its significance is given in the same Protocol where it states that this signal is a warning that a train is approaching and orders road traffic to stop. Here the divergencies begin to appear : some take it that the stop is an absolute stop and the road user who runs past the stop signal is to blame and liable to be summonsed; others consider that the vehicle having come to a stop, the road user is free to cross on his own responsibility, taking steps to safeguard himself by ascertaining the state of the track, which means that the visibility at the crossing must be sufficiently good. Obviously, it is of the greatest interest especially in the case of international traffic, that there should be uniformity of practice. The permissive stop appears logical if the visibility at the crossing is sufficiently good so that the road user can cross without danger. It has the great advantage of deciding what is to be done should the danger signal persist owing to a defect in the installation.

This position has been adopted by the South African Railways and the S. N. C. B. It is favoured by the S. N. C. F. The replies received to the questionnaire did not enable us to ascertain the opinions of most Administrations on this point. We shall see further on that when there are half-gates, the question is rather more complicated, but does not appear insolvable. This is a matter that needs settling.

*— Should a positive line clear signal be given?*

The Swedish State gives such a signal as does the S. N. C. B., the Norwegian State and the Netherlands Railways.

The Danish State, the South African Railways and the Swiss Federal Railways do not.

It does not appear that such a signal is given by the American Railways.

Those in favour of a line clear indication point out that it enables the danger indication to be completely extinguished. This supposes that the road users know the level crossing has no keeper and is equipped with automatic signalling and is not a level crossing without automatic signalling. Others consider that such an indication shows what sort of a level crossing it is, which is the contrary to the above opinion.

In Sweden, the question is very much debated; it has been the subject of an extensive enquiry and the final decision has not yet been reached. Denmark, on the contrary, is against a line clear indication considering that such a positive indication cannot be given with 100 % safety.

Without going back to the discussion in M. Donzeau's report, it appears that a solution like that perfected by the S. N. C. F. where, should the light go out, the danger indication is still given by a sign, does away with the difficulties which occur should anything go wrong through the light going out, so that it is unnecessary to give a positive line clear signal which, moreover, is not laid down in the Geneva Protocol, and the absence of which leads to great savings in operating and capital costs.

*— Addition of half-gates or gates.*

As these are a more imperative stop signal than a light signal, half-gates are generally considered to increase the safety, especially in the case of double track lines, although a certain number of Administrations consider that lights alone are sufficient in many cases, even when there are two tracks. The opinion of the Swedish State Railways should be noted however, they are definitely against light signals only in the case of double track lines. (We would point out in passing that Sweden uses entirely automatic gates in a few instances. This device, which is not in general use, obviously makes it necessary to provide a keeper immediately anything goes wrong.)

There is no doubt that quite apart from their value from the safety point of view, half-gates do occasion some difficulty should they go wrong in the case of a level crossing with heavy road traffic. But the importance of this difficulty must not be exaggerated if easily lifted types of half gates are used, like those used on the American Railways. In the present state of the question, it seems possible to state that half-gates add to the safety of level crossings, particularly when there are two tracks, and appear to make it possible to extend the number of level crossings which can be operated without keepers with light signals.

*Field of application.*

The field of application laid down by the different Administrations varies considerably, some of them having no hesitation in applying this system to very important level crossings with heavy traffic moments (10 000 on the S. N. C. B. and Deutsche Bundesbahn, 25 000 without half-gates and double this amount with half-gates on the Netherlands Railways); Administrations such as the S. N. C. F., which have as yet no experience of the system, are more timid. We have seen that the addition of half-gates can extend the field of application of this system.

*— Duration of the warning*

It is unanimously agreed that the warning should be brief. This stresses the value of equipment, which will give an appreciably constant warning whatever the speed of the train. It is to be feared that the cost of such equipment makes its general use impracticable.

*Various.*

In accordance with the usual safety regulations on the railways, as far as possible any failure or breakdown which may occur with automatic signalling at level crossings without keepers should result in a danger indication being given to the road user, the indication being in a reduced form if the breakdown affects one element of the signal in question; when the signal remains at danger indefinitely in this way, the road user has to cross the level crossing after he has made sure no train is approaching, so that the visibility at the crossing must be sufficiently good. It would be a good thing if uniform regulations were issued regarding the steps to be taken by road users when a breakdown has occurred.

It should be noted that careful siting of the road signals is necessary, as there may be bends in the road near the crossing.

The methods by which the railway staff are advised of breakdowns is not laid down by every Administration; some of them make a nearby signal box responsible, others the trains. They endeavour to give it at such a distance from the crossing that brakes can be effectively applied. Here we are getting close to protection of level crossings by train signals. It will be necessary to see should it become the general practice to equip level crossings with such equipment, whether the multiplicity of signals to be observed will not confuse the train drivers. Moreover, real protection by means of interlocked signals, apart from the high cost of such an installation, risks making the warning unduly prolonged on lines runs over by both fast and slow trains, which would encourage road users to get into the habit of disregarding the signals.

Finally, there is the question of trains coming in the opposite direction on level crossings without keepers with automatic signalling over double track lines. There appear to be various solutions to this problem according to the importance of the line.

## CHAPTER III.

### Proposed summaries.

*QUESTION I A.*

1. — The changes that have occurred in the character of the road traffic in modern times, owing to the development of motor traffic and the progressive increase in the number, speed, and tonnage of such vehicles, means that the way level crossings are operated and equipped must be carefully studied by the railway Administrations and public authorities in order to make the necessary modifications.

In endeavouring to improve the safety at level crossings, financial considerations are of great importance, as the general interest makes it necessary to see that the capital available is spent to the best purpose, as always. These considerations make it necessary for the railway Administrations and authorities controlling them to grade as far as possible the way level crossings are equipped according to the possible risks, and on the other hand to make every possible economy without hazarding the necessary degree of safety at those level crossings where such economies are possible in order to finance the cost of equipping more elaborately other more dangerous level crossings.

In any case, it is unjust that the financial cost involved in improving the standard of safety at level crossings should be borne by the railway alone.

2. — In general, substantial improvements have been made in many countries since the Cairo Congress regarding safety at level crossings, particularly as regards :

— the facilities given to road users to warn them of the existence of all kinds of level crossings and to enable them to see when the gates are shut at level crossings with keepers;

— the methods of advising the arrival of trains given to the keepers at level crossings with keepers;

— improvements to the types of gates.

The regulations of the Geneva Protocol regarding signalling the presence of level crossings have been supported by a very large number of countries, which results in an improved standard of safety both for the usual road users and for road users making international journeys.

3. — There is now available very reliable equipment which enables an automatic signal giving warning of the approach of a train to be given to road users coming up to level crossings without keepers. Such equipment can be installed and operated relatively economically, particularly if no positive line clear light is included, as this involves using a large amount of current and the obligatory use of the power from local supply.

4. — Apart from the above considerations of economy, if an exception is made of level crossings with keepers protected by signals with mutual interlocking between such signals and the gates and train signals, when the train is stopped if the keeper makes any mistake, the general introduction of which would lead to serious drawbacks, both financial ones and practical ones as regards the flow of road traffic and the regularity of the trains, it can be stated that giving a danger signal at a level crossing without a keeper with automatic warning of the approach of trains is not only just as safe but even safer than having the gates closed by a keeper in the case of a level crossing with a keeper.

5. — There remains a great deal to be done however to discipline road users, as the danger signal, in the case of automatic signalling, unlike a gate, at least when such a signal is merely a coloured light, is not a material obstacle preventing the level crossing being run onto. It is to be feared than unless such discipline improves, accidents at level crossings without keepers where there is automatic signalling, will have more serious consequences, although in making such a comparison we must not overlook the risk of accidents owing to a road vehicle running into the gates of a level crossing with a keeper and thereby blocking the line, when had there been no gates the vehicle might have crossed over without danger.

It appears that the addition of light automatic half-gates may cancel out the difference in the reactions of road users, according to whether they find themselves faced with the closed gates of a level crossing with a keeper or the automatic stop signal at a level crossing without a keeper. In addition, half-gates seem likely to lessen the special risks at double track crossings when the road user is tempted to cross as soon as one train has passed without considering another might be coming in the opposite direction.

It is extremely desirable that in view of the special case of such double crossings, as for all level crossings moreover where there are no keepers, when cattle have to cross, the regulations should be clearly laid down and strictly enforced, wherever this is not yet done.

6. — In view of the probability that the system without keepers with automatic signalling is likely to be extended, it is very desirable in order to make it easier for international traffic to know and observe the regulations, that uniformity should exist as regards the following points :

— type of signals;

— whether there is or is not a positive line clear indication;

— the exact meaning of the danger signal given (absolute stop or permissive stop) :

— in the case of level crossings without keepers, the adoption of a road signal at a distance from the crossing, showing whether the crossing in question is or is not equipped with automatic signalling;

— systematic use at the crossing itself of the St. Andrews Cross sign with a double cross in the case of double track line (or some other signal designed with the same object);

— definition of what the road user should do when anything is out of order.

7. — Doing away with keepers is a definite source of economy. In addition, it is also of general interest in that labour is freed for use on more productive sections.

There are a fair number of cases in which the characteristics of the level crossing: amount and kind of road traffic, amount of railway traffic, visibility, enable such a crossing to be operated as a crossing without keeper without signals with sufficient safety. Regulations concerning keeping the view open near level crossings are likely to facilitate the extension of this practice and also improve the safety.

The question of deciding whether it is possible to substitute on a large scale the system without keeper with automatic warning of the approach of trains to that of having a keeper should be gone into very carefully. At the present time, it does not appear possible to decide the upper limits at which such a substitution is applicable, as such limits vary according to the education and discipline of the road users: in countries where automatic warning of the approach of trains is not widely used, it appears advisable to fix such limits very prudently, as they can always be extended later on. Moreover, it appears that the addition of automatic half-gates makes it possible to extend these limits, especially in the case of double track crossings. Such half-gates should be very light so that there will not be any serious consequences if they are run into. The addition of automatic gates right across the road is still more satisfactory as regards the behaviour of the road users, but this raises very serious problems should anything go wrong with the installation, so that their general use appears impracticable; automatic gates also raise the problem of what kind of distant road signal should be used.

8. — In the case of level crossings without keepers without signals, the installation of automatic signals giving warning of the approach of trains appears a solution to be recommended when an increase in the amount, speed and tonnage of the road traffic jeopardises the safety of the existing system and the problem cannot be solved in any other way, such as by reducing the speed of the road and railway traffic, increasing the visibility, undertaking various work such as cutting back banks, and introducing regulations about keeping the view clear at level crossings.

It is only just that the cost of improving the standard of safety, however this is done, should not be borne by the railway.

9. — Apart from the British Railways, where there are a great many private level crossings leading to numerous complications, it does not appear that such crossings cause any great difficulties to the different railway Administrations.

It appears desirable however that their number should not be increased. If new private level crossings are made, it appears essential to stipulate that the visibility should be at least as good as that required at level crossings without keepers without automatic signalling.

If they are to be used by any specially large vehicles, it is to be recommended that the users should give the railway Administration preliminary warning.

Finally, it is essential that there should be good discipline amongst those using private level crossings as regards their obligations to close and lock the gates and indicate the presence of such a crossing by a sign clearly indicating its character.

10. — The methods now used by the different Administrations to prepare statistics of accidents at level crossings make it very hard to come to any conclusions about them. Thus, whilst recognising the complexity of the question, the Commission expresses a wish that the uniform preparation of as detailed as possible statistical tables should be studied.

* * *

## *QUESTION I B.*

The problem of a level crossing at which an urban or suburban line runs alongside the road seems to have been dealt with on more or less the same lines in the different countries. In principle, the level crossings in question have keepers.

If the urban or suburban railway does not run on sight, the crossing is exactly the same as that of the crossing of two railway lines, priority being given in principle to the main line trains.

If the urban or suburban line runs on sight at the level crossing, this is usually treated just like an ordinary level crossing, which is protected if necessary by signals on the line. In certain cases, derailing points have been fitted on the secondary line to protect the crossing when closed.

The enquiry only revealed very rare instances of level crossings without keepers with automatic signalling at which an urban or suburban line ran alongside the road. No particular measures appear to have been taken in connection with such level crossings.

# SECTION III. — Working.

[ 656 .225 & 656 .261 ]

## QUESTION II.

**What are the quickest and most economical means to carry out door to door service for railway transports?**

**What are the best conditions of use of containers for small miscellaneous traffic (dimensions of the containers, conditions of ownership, tariffs)?**

**What are the packing types to be recommended?**

## SPECIAL REPORT,

by F. Sauvageat,

Adjoint au Chef de l'Exploitation du 1er Arrondissement des Chemins de fer fédéraux suisses.

This question was covered by the two following reports :

Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, China, Egypt, India, Irak, Iran, Irish Free State, New Zealand, Pakistan, South Africa, Sudan, United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by Dr. M. G. De Bruin (see *Bulletin* for February 1952, p. 79).

Report (Austria, Belgium and Colonies, Bulgaria, Czechoslovakia, Denmark, France and French Union, Finland, Western Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Norway, Poland, Portugal and Colonies, Rumania, Spain, Sweden, Syria, Switzerland, Turkey, Yugoslavia), by M. F. Sauvageat (see *Bulletin* for May 1952, p. 397).

The object of the present report is to sum up the reports of these two reporters and, as far as is possible, formulate certain summaries to be discussed at the Enlarged Meeting of the Permanent Commission at Stockholm.

A questionnaire prepared in collaboration by Dr M. F. Gerst and the Special Reporter, in agreement with the General Secretariat of the Association, was sent out to one hundred Administrations; fifty-seven of them replied, amongst whom twenty-four were able to give detailed information.

We wish to thank those Administrations who were good enough to reply to the many and diverse questions asked them. The important information supplied by some of them enabled the reporters to condense many interesting data which made it possible to prepare the foundation for a certain number of summaries. However, it should be pointed out that various data, which would have been extremely useful for making a comparison of the costs, could not be supplied for reasons explained by the reporters in their reports.

Dr. De Bruin, the reporter for the English speaking countries, stresses in particular the fact that the replies to questions dealing with the comparison of the costs of the various Administrations only gave general details about the advantages and drawbacks of certain systems, whereas actual figures

relating to these costs, the figures in support of these advantages or drawbacks, were lacking.

The amplitude and multiple aspects of the question dealt with, and above all the fact that many new methods are still in the experimental stage in numerous countries did not facilitate the task of the Administrations. It is not surprising, therefore, that they were not in a position to give all the figures asked for in the questionnaire.

The reporters took great pains to sum up in various tables, in as instructive a way as possible, the details they were given. Although for the reasons indicated above, some of these tables are incomplete, nonetheless they contain a great many details which the Administrations should be able to complete when they have finished the experiments now being carried out with certain devices, machines or equipment.

The first part of the questionnaire made a discrimination between the door to door services in connection with full loads and those for part loads (parcels traffic). This distinction was considered useful in order to make it possible, if necessary, to compare the work in connection with Question VIII of the XVth Session of the Association (Rome 1950) and that in connection with the present question.

Whereas the Rome Congress in discussing this question took pains in particular to formulate summaries which would promote the development of methods designed to extend the door to door technique to full loads (using the railway for the main part of the journey), the next Meeting of the Permanent Commission will be asked to devote special attention to the rapidity and efficiency of the various methods which have already been approved or are still under trial.

It is a question therefore of deciding what devices give the best output and are of the greatest value to the railway, in other words, which technical and commercial methods play the greatest part in improving the door to door services, whilst guaranteeing an economic method of working, likely to have a good effect upon the costs and consequently upon the prices charged to the clients.

All the railways are very much concerned with the problem of door to door transport at the present time; consequently, it seems permissible to think that the summaries, which were adopted in 1950 when the above mentioned question was discussed, cannot fail to have raised an echo in the mind of those who have to deal with this most important subject. Moreover, the very high cost of handling goods leads the railways ever more and more to have recourse to improved technical methods, intended to give better conditions in the door to door services without transhipment of the goods.

However the different methods used by the railways are legion. The reporters described some of the new methods and gave details about the evolution of the different technical methods during these last years. The Administrations are now making an all out effort both on the technical and on the commercial side to make the methods used in connection with their terminal transport more efficient. In spite of the importance of private sidings, which is confirmed by the high percentage of traffic using them given by the reporters, the different devices and equipment [wagon-conveying trailers, special and ordinary containers pa (*)] used in the door to door services are playing an ever more important part in the struggle the railway has to keep up against its competitors.

The use of technical methods intended to speed up terminal transport, in addition to the advantages obtained as regards production, assists in the rapid liberation of wagons (better turnround), lower costs owing to the speeding up of the operations, and a saving in labour. They make it

(*) « Containers pa » are containers involving the use of special carriers.

possible in addition to prevent damage and reduce accidents at work (less manual effort). But in order that all these advantages shall not be made illusionary owing to the high cost in general of such equipment or devices, it is very important that they should work to capacity. This unfortunately is not always the case. It is therefore very necessary to know which of the different technical means of assuring door to door services is the best adapted to the special conditions obtaining (geographical, technical and commercial) with the transport in question.

Dr. De Bruin in his considerations on this question gave the principle upon which the British Railways base their efforts to secure door to door transport, which it seems opportune to repeat at this point :

« Door-to-door service is best given by combining the maximum use of ordinary cartage equipment with the use of containers and ordinary rail wagons. Every departure from the ordinary means the provision and maintenance of special and expensive equipment, for which full employment may not be available. »

Mr. De Bruin adds that this idea might, at least as far as conditions in Great Britain are concerned, be taken as a direct reply to the question of door to door services for full loads.

The pertinency of this remark should be stressed, as those railways which use special devices such as unloaders for special containers | pa |, recognise that such equipment must be used intensively if the cost is to be reasonable and this condition is not always fulfilled. Let us hasten to add, however, that the Netherlands Railways which have about 2 500 special containers | pa |, and make use of no other devices for door to door transport, have obtained satisfactory results with their D. A. F. unloaders (lower costs than in the case of motor lorries), thanks to a careful commercial organization (agreements with clients) and the concentration of the traffic at certain centre-stations. It should be noted however that some of the depot stations do not always have sufficient traffic to keep the unloaders fully used. This has also been found to be the case in Germany and Switzerland where to do away with the drawbacks of too great specialization and the resulting ties, the Administrations concerned have found it necessary to make their | pa | container services more flexible by the invention of simpler devices than the D. A. F. unloaders. In this way, they overcome the disadvantages of a single type of specialised and costly equipment and have brought down the cost of transport by means of containers | pa | to a more reasonable level in those districts where the traffic is insufficient to justify the use of costly equipment.

As regards the problem of packings, its magnitude and diversity led us to concentrate our attention upon a methodical analysis of one of its aspects which we consider to be the most topical.

We think this can be defined as follows :

« *Ways of increasing the benefits which the consignor and transporter will reap from the use of more efficient packing of goods.* »

We will endeavour to define the functions and purpose of packings. We will examine in turn their usefulness for the consignor, the first and chief person concerned, as well as for the transporter. Passing from ideas to actual figures, we will study the effects of the packing on the cost of railway transport. Finally, to conclude, we will indicate the methods by which the transporter can encourage the consignor to make use of the most suitable packings.

To sum up the considerations given in the two reports and to endeavour to formulate summaries, we give below in a condensed form, the points dealt with in the same order as that used by the reporters.

## A. Full loads.

*Private sidings and client's depots at stations.*

The reporters agree in stating that the replies of the Administrations consulted did not reveal any different factors than those which led to summaries Nos. 6 and 13 of the XVth Session of the Congress (Rome 1950).

In his report Dr. DE BRUIN points out that with practically only one exception all the Administrations of the countries which replied consider that private sidings should be encouraged, but on the other hand the railway should not take over all or part of the cost of making such sidings.

Some Administrations make available to clients covered or open sites at stations for their goods on advantageous terms, this being the practice on the British Railways, who find their Railhead Distribution system very fruitful.

The Continental Railways, in general, consider it advisable to encourage the development of private sidings, either by sharing in the cost of making them in one way or another, or by granting reductions in the operating costs or again by tariff reductions.

The importance of the connecting siding for the methodical development of sidings has not escaped the notice of any railway. Consequently, the railways would find it advantageous to pay particular attention to this point.

On the other hand, it must be stressed that the existence of private sidings saves the railway the relatively high cost of maintaining and even extending the sidings in the stations.

*Wagon-conveying trailers.*

In hilly countries, the wagon-conveying trailer has been found by certain Administrations to be the most useful method of improving the door to door services. Their services are equally valuable however in large towns where it is not possible to make any new sidings.

The disadvantage of this system is the very high cost of the trailer and the tractor needed to pull it.

The new folding up trailer of the German Railways deserves particular attention in view of the high speeds obtained, an advantage which contributes to a reduction in the costs.

It should be noted that this type of equipment is not used outside the European continent.

*Large containers.*

In the first part of this report, we drew attention to the principle applied by the British Railways as regards the organization of door to door services by means of containers and ordinary wagons and road vehicles. In Great Britain, containers are usually loaded onto standard open wagons, but a considerable number of rail-chassis are also in use for special types of containers and tanks.

All the types of containers mentioned here involve the use of lifting tackle (cranes) at the stations. It can be agreed that most of these containers can be transported on ordinary motor lorries or standard types of trailers and that the unloading of the contents (leaving the containers on the road vehicles) is the usual practice when no lifting tackle is available at client's premises.

In this country, containers without wheels are preferred and everything is done to encourage the construction of such containers, in order to avoid, as stated by the British Railways, the use of special types of wagons and the tying up of capital in wheels, tyres, axles, brakes, springs, etc., which will not be used during the rail part of the journey.

M. DE BRUIN reports that in Great Britain containers are available for the transport of nearly every category of goods.

In view of the fact that the technique of transport by means of large containers was examined in detail at the Rome Congress, the reporter thinks he can refer readers to summaries Nos. 8, 9 and 10, adopted after discussion of Question VIII, which still apply today.

To facilitate grouping and the full use being made of the rolling stock, it is an advantage to be able to use the type of container most suitable for the amount and nature of the goods to be transported. The classical types of containers without wheels, owing to their great variety, seem to be particularly well adapted to grouping. Although they involve lifting gear at the stations and at client's premises, it may be asked whether, at least on the main part of the journey (by rail), they are not preferable to special |pa| containers which can only be grouped in threes on a wagon. The reporter thinks that it is opportune to go into this question in view of the tendencies in the different countries in favour of one or other of these two methods. Each of them has indeed its advantages and its drawbacks. Thus it appears that the Administrations have a real interest in continuing trials of both methods. Later on, this will enable them to draw up a balance sheet for each method, seeing that the technique of door to door transport by means of large special |pa| containers is now in full evolution and that certain equipment or devices are still under trial, especially in Germany and Switzerland and have still to prove their worth.

We will not be betraying the views of the International Railway Congress Association moreover in stating that both methods can very well exist side by side (see Question VIII, summary No. 9 of the Rome Session 1950).

*Rail-road trailers.*

The use of rail-road trailers on a large scale is limited to France. In Great Britain and Ireland, they are not yet used to any great extent. Trials have been reported in Switzerland and Sweden, and Austria proposes to put trailers of this type into service between Vorarlberg and Lower Austria. The South African Railways also are considering introducing trailers of this type.

The advantages of the rail-road trailer were fully gone into in the report covering the countries of Continental Europe.

*Full loads transhipped at the station.*

As M. De Bruin reports, the manual transhipment of goods by means of small tools is the usual practice on all the Administrations and in particular as reported by the British Railways: « For consignments consisting of a large number of separate parcels for which cranes or other mechanical methods would be neither economical nor practical. » Gantries and other fixed and moveable cranes are used for heavy loads, such as containers.

Electro-magnetic devices which are fixed to cranes for handling heavy iron or steel goods deserve mention.

Amongst other gear, let us mention fork-lift trucks, in combination with pallets, lifting devices, cable conveyors, belt or chain conveyors, and finally pipe-lines and motor pumps. These devices, most of which are classical, have already been described previously. Mention must however be made of the remarkable development of new motor cranes of different types. The mechanization of the fixed cranes in the stations must also be stressed, in view of the saving in the labour thereby obtained (the Austrian Railways mention a saving of 60 to 70 % for example) as well as the speeding up of the work.

### B. Part loads and small goods assembled in large consigments.

*Small containers up to 3 $m^3$ (106 cub. ft.).*

Dr. De Bruin points out in his report that none of the Administrations consulted uses

containers of this sort, so that there is no need for us to complete or comment upon the summary given in the report concerning the countries of the European continent which the reader can consult in the May 1952 *Bulletin*, p. 465.

*Pallets and other devices.*

The use of pallets is being developed to a most satisfactory extent in certain European countries. In Great Britain, this method has also been in use since 1949. M. DE BRUIN reports, in particular, that the use of pallets does not involve any structural alterations to existing installations. In our eyes, this is a marked advantage over the system of mechanized depots, which involves important alterations and immobilizations.

The pallet only finds its full interest when used conjointly by the producers, the stockist, the transporter and the consignee. Each one then obtains the greatest advantage from using it and the ease of handling obtained when carrying out door to door services can help the railway to retain clients, who are fearful of complicated handling operations which result in damage and disatisfaction.

To attain this object, it is necessary for the parcels, collected together into lots corresponding to the capacity of the pallets and the power of the fork-lift trucks, to be transported as far as possible without changing pallets.

The use of pallets from one end of the journey to the other does away with the handling of relatively small loads, which always costs more in view of the extra labour costs involved.

Palletization must however take the following facts into account : the tariffs for the loaded and empty runs, stowing in the wagons and depots, the difficulties of getting access to and manœuvring the vehicles in the wagons, the strength of the floors, and the ownership of the pallets (pool).

On the same lines as pallets, stillages are used in Great Britain, which have wheels at one end and supports at the other. The wheels enable them to be pushed small distances when loaded without having to get the assistance of a motor elevator truck, thanks to the use of wheeled gear at the other end.

M. DE BRUIN in his report also describes the mechanical handling methods used in this country. These are fixed or mobile belt conveyors and gear to unload wagons designed on the same principles as a belt conveyor in order to tranship small consignments from the wagon onto the road vehicles or to take them to the first marshalling point from which they will finally be taken to a road vehicle.

The devices most frequently used for handling at the stations have been mentioned by the reporters and a few comparisons of costs made. The advantages of mechanical handling are very obvious. They are shown by the speeding up of operations, the use of less labour, the men being in addition exposed to less fatigue and consequently to less risk of accident.

## C. Packing.

*1. Function of the packing.*

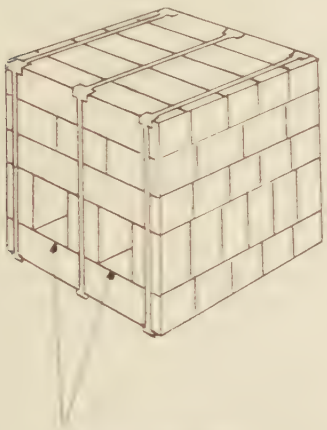
The packing, in the widest sense of the term, fulfils several functions, the chief of which are :

a) *to contain* gases, liquids, powders, and granules which owing to their fluidity could not be transported in any other way unless by pipeline. Prototypes : pots, bins, sacks. Types evolved : hopper-wagons, tank-containers;

b) *to collect together into units of suitable size for handling* and transporting very small production or consumption units. Prototype : the bond holding together the straws of a sheaf. Types evolved : pallets, strap-iron, « Unit load » (1);

(1) Unit Load : Collection of various parcels (by means of a strap-iron or similar method), leaving spaces in the whole for the forks of the elevator-tractor (see illustration).

c) *to modify the outer form* of the goods and make them more or less parallelepipedic or cylindrical (unless they already are so) and *to standardize their dimensions.* Prototypes : basket, drum, bin. Types evolved : drum, can, collico case, container;




Points d'entrées de la fourche de l'élévateur = spaces for the fork of the elevator.

d) *to protect* the goods *against transport risks :* risks of loss, theft, shock, wet, heat, frost. Prototypes : the basket, the parcel made with string and paper. Types evolved : containers, box-pallets, insulated wagons, refrigerator wagons, etc;

e) *to give a standardized appearance* with a *publicity* value; to contribute to the establishment of business transactions by guaranteeing a given volume, tare, constant net weight, even if necessary setting the price of each item. This function can be considered as a modern development, the fruit of manufacturing and packing goods on mass production lines. With very few exceptions, it is a child of the XXth Century, and now in full flight.

Of these five different functions, only the first four would appear to interest most transport undertakings. The latter would however have every interest in seeing that the best packing from the publicity point of view corresponds with the best packing from the transport point of view, as is already the case for several agricultural products (fruit and vegetables), as these will take the form of a *once-used packing,* designed for a single journey, giving a much greater coefficient of safety for the same cost, or costing much less for the same degree of safety.

*2. Usefulness of the packing for the consignor*

a) *Fluid goods.*

Where the traffic and nature of the goods do not justify a pipeline (which might be considered as a kind of packing) it is not possible to transport fluid goods such as gases, liquids, powders and granules without packing. It is necessary however to explain that the transporters have endeavoured to make the packing and the vehicle a single unit, which explains the favour enjoyed by boats, tank wagons and lorries, corn wagons, lime wagons, mineral wagons, etc., but does not exclude the use of barrels, containers and other smaller packings.

The impossibility of doing without any packing (unless it is a case of pipe-lines) makes it unnecessary for us to seek justification for this anywhere else.

The choice of the type of packing will depend above all on the importance of the unit to be transported and the capacity of the least well equipped methods of transport in the series responsible for the door to door service;

b) *Other materials : solids.*

For these, the packing is not an indispensable part. Consequently, the *cost* has to be *justified.* Let us leave on one side the packing whose character is pure advertisement, the utility of which is obvious.

Do the savings made possible by its use justify of themselves the cost of the pack-

ing? What are these savings? This is the problem.

According to the type of packing, according to the kind of goods, we will get:

1) *A decrease in the cost of handling.*

— Collecting the goods together in large units for handling reduces the total number of manipulations necessary between production and consumption; this reduction is the greater as the number of manipulations increases and, up to a certain point, the number of units grouped together, is the larger (see chap. 4).

Modifications made to the outward form of packings facilitates:

*in the case of parallelepipedic shapes,* the simultaneous mechanical handling of several parcels by means of elevator-tractors or cranes, especially if the dimensions are standardized;

*in the case of cylindrical shapes,* manual handling by rolling.

The stacking of parcels in addition assists in reducing the horizontal mileage.

2) *Reduced warehouse costs.*

— The better use of the stocking space (in height) obtained by the outer form of packings, helps to reduce the area needed for stocking (whether divided into one or several stories) and consequently the capital invested.

3) In so far as it assists in reducing the risk of damage inherent in all transport, *the packing can be considered as a sort of insurance, its cost being the premium.*

The choice of the method of packing depends on weighing the cost of the packing on the one hand against the savings which the consignor expects to make on this account on the other, or in other words, an endeavour to find the optimum packings assuring the greatest benefit.

The final balance must not show a deficit however, as this might lead the consignor, if he is a free agent, not to pack his goods at all. The transporter would then have to intervene. We will see if he can do so, and in what way.

3. *The usefulness of packing for the transporter.*

Does effective packing of goods give the transporter any advantages so that he endeavour to extend its use, or even to improve upon it?

The Railways are unanimous in recognising this point.

The advantage obtained by the transporter comes under the same headings as for the consignor, but the field of application is different.

*The advantage due to the grouping together of small units* is only apparent to the transporter in the case of consignments which he has to deal with, consequently in most cases part loads which only represent a part of railway traffic.

*The advantage obtained by the better outward form,* in so far as this reduces handling costs, is only of value, as above, in the case of part loads; in so far as it contributes towards better user of the available space and facilitates stowing the parcels, it also applies with increasing interest to full loads made up of various isolated consignments.

*The advantage obtained by the better protection afforded* finally affects all consignments whatever method of handling be used. The profit obtained therefrom by the transporter will obviously *depend* upon *his share of the responsibility,* which by reason of the laws, tariffs and regulations in force in each country or on each railway, falls upon each party to the transport contract.

An examination of the repercussions of these advantages upon the costs will be the subject of the next chapter.

4. *Influence of the kind of packing upon the cost of railway transport.*

The weight of the packing being added

to that of the goods when calculating the cost of the transport, heavy packings will have the effect of increasing the receipts whilst increasing *traction costs.* This influence does not appear to us of any great importance and we will not go into it.

With regard to the operating costs of trains, they could not be greatly affected by a change in the system of packing; and we will leave them out.

*The grouping together of small units by means of the packing* (whether this be a simple bond or protective casing) as well as *the choice of the outward form suitable* for standardized dimensions, will make it possible to reduce the number of handling operations and facilitate mechanization (pallets, unit-loads, etc.) and thereby *contribute to reducing* the working time and consequently *the labour costs for handling.* The saving obtained will vary according to the packing, according to the extent to which grouping is carried out, and according to the improvements made in the form and manageability of the parcels.

For each method of handling: manual or mechanical, there are optimum shapes as well as optimum dimensions and weights.

It must also be pointed out that the packing can also definitely influence the *relative costs of the rolling stock.* For example, the effective packing of dirty or corrosive materials will reduce *maintenance costs.* Then *watertight packings* (especially in containers) will enable goods normally carried in covered wagons (in the hold, by sea) *to be loaded onto open wagons* (on the deck, by sea). It is a well known fact that open wagons cost less to buy and maintain.

Finally, *packings which facilitate stacking,* with *standardized* dimensions (on conditions that these standards correspond to those of the wagons) will make possible the *maximum use of the wagon capacity,* even if the consignment comes from several consignors or consists of very diverse goods.

*As the best protection of goods, the choice of adequate forms facilitating the stowing of individual parcels* and greater cohesion of the whole load will contribute towards reducing that part of the damages which the transporter has to pay for. Both these factors will directly affect the *transport assurance premium,* whether this is paid to a third party or simply included in the costs (auto-assurance).

If it is easy to imagine the profit which the transporter derives from effective packings, it is unfortunately very difficult to estimate its full results and give an actual figure to the saving obtained.

5. *The price the transporter is prepared to pay to contribute towards the improvement of packings.*

In countries or districts where the transporter enjoys a monopoly in fact or by law, it is easy for him to *impose,* by means of his tariffs or regulations, whatever method of packing he considers best and this will not cost him anything in practice.

It is quite different when there is free competition. If he wants to insist upon a given type of packing, the transporter risks helping his competitors. He has to be content with protecting human health, his stock, and the goods carried by regulating the packing of dangerous or infectious materials, at the instigation or with the approval of the authorities.

As regards the packing of all the other goods, he will only be able to try the persuasive manner.

As we saw above, the consignor generally profits by careful packing; in this case, the part played by the transporter *can be limited to giving advice,* making use of his experience, and of his test laboratories to contribute towards research into the kind of packing that will give the maximum effectiveness at the lowest cost. The contribution of the transporter will be summed up in labour costs (inspectors, information offices), in laboratory costs to which perhaps will be added the cost of publicity (posters, films, announcements, etc.).

It may however happen that owing to modifications in the price structure of the raw materials required in the manufacture of packing materials, or because of the facilities granted by competition, that the consignor finds the profit he derives from the packing is reduced and consequently endeavours to do away with it or at least reduce its cost.

What is the transporter to do in such a case?

As he can no longer be content merely to advise, he has to choose between two fundamentally different attitudes:

*passive,* is he to allow methods of packing which he can but condemn without doing anything about it? Must he give up the advantages of adequate packings without a struggle?

*active,* or will he fight against it, supporting his recommendations by a tariff policy favouring good packings (and consequently penalising poor packings)? Which means in other words that he is prepared to *share the benefits reaped from good packings with the consignor.*

The railways who have resolutely embarked on an active policy are indeed rare. And yet, the experiments attempted by certain Administrations over a restricted field: containers, collico cases, packings for eggs, fruit, preserves, furniture and textiles, have proved their effectiveness.

Benefits are too often granted for *returned empties* in the case of inadequate, insufficient, even dangerous packings, whose cost cannot justify the practice, proving the disorder induced by the appearance and strengthening of road competition, the fear which sometimes paralyses and weakens the railway, throwing it on the defensive rather than on the offensive.

The examination of such a tariff policy however lies outside the scope of the present question. We can only wish that the point will be taken up again later.

**Summaries.**

1. The ever growing cost of handling operations and the speeding up of competitive road methods oblige the railway increasingly to have recourse to improved technical methods in order to realise door to door transport with the maximum speed at the minimum cost and damages.

2. The private siding still remains the most economical way of assuring the door to door technique, on condition that the capital costs are spread over a large number of wagons, that operating costs are reasonable, and that the siding is so laid out that the wagons can be brought right up to the required sites.

3. In order to reduce the cost of private sidings linked up with the stations by lines common to several firms (feeder sidings), the railway should devote the greatest care to such sidings and consider to what extent it is profitable to share in financing them.

4. Certain railways attach great importance to letting their clients have depots in their stations or goods depots under very favourable conditions.

5. Where it is not possible to build new private sidings or there is no justification for them, the container, the wagon-conveying trailer and the rail-road trailer are auxiliary methods which enable full loads to be taken to the client's premises, thereby assuring a close link between the railway and its clients.

6. From the point of view of speed, provided the carting distance is short, there is not much to choose between the three methods.

From the point of view of cost, the container is undoubtedly the cheapest method but the more expensive road-rail trailer can sometimes be justified in certain circumstances. The more expensive wagon-carrying trailer can only be justified by such circumstances as the special character of

the traffic or the impracticability of using other methods.

7. Certain railways consider that the best way of assuring door to door services by means of containers is to make the greatest possible use of the usual haulage vehicles and standard wagons.

Special transport equipment may involve the multiplication of types of equipment and the risk of a less intensive and therefore more costly user.

However, the quality of the service given to clients by means of special containers pa| , and by means of rail-road trailers may justify the higher costs.

8. Looking to the more distant future, it may well be that the door to door problem as it concerns full wagon loads (apart from the private siding solution) will be solved by establishing central container yards, well-equipped in all respects, and served by high-speed container trains and cartage vehicles operating over wide areas.

Such a development should also aim at the maximum standardization of equipment and the facilitation of international traffic movement.

9. Small containers of 1 to 3 cubic metres (35 to 106 cub. ft.) on wheels, large numbers of which are used on the continent of Europe, are operated in two different ways : in the one case, they belong to the transporter (railway or affiliated company), and in the other, to private firms. As a general rule, they are loaded by the user.

The clientele seems to prefer containers of 1 to 2 cubic metres (35 to 70 cub. ft.).

Privately owned containers (those belonging to consigning firms excepted) find it difficult to obtain a load for the return journey, chiefly on account of ther specialization, so that the empty mileage tends to equal the loaded mileage, which is costly for the railway, even if empty containers are charged, owing to their low specific weight.

The railway has every interest in limiting empty runs, either by a policy of acquiring its own containers (under its own management or farmed out), or by effective tariff measures.

10. Pallets and box-pallets used in conjunction with fork-lift trucks can prove of real advantage in handling parcels, which are transported grouped into consignments of a certain size.

The full advantage is taken of pallets only when they are conjointly used by the producer, the stockist, the transporter and the consignee. Their advantage increases according to the number of handlings involved.

The parcels grouped into lots corresponding to the capacity of the pallets and the power of the fork-lift trucks should remain if possible loaded on the same pallets throughout the journey.

The most economical method of operation appears to involve the use of standardized pallets from a pool, this pool being owned in common by the transporters and the business firms involved.

In any case, it is necessary to assure that the ownership of the pallets and the tariffs for empty and loaded runs should be so established that the railway receives a fair payment for the additional loads it carries.

11. Packings justify their cost by the services rendered to the consignor and the transporter. The packing contains or holds the goods together and protects them; it often modifies their form. The consignor can use it for publicity purposes, without the cost being appreciably modified thereby.

12. Effective packing makes it possible to reduce handling and depot costs, as well as the transport assurance premium paid by the consignor.

13. The method of packing influences the cost of the transport and in particular the cost of handling, capital costs and maintenance costs for the stock, as well as the sums paid out in damages.

14. The lack of a monopoly generally makes it impossible to use compulsion, so that the transporter has to be content with trying to persuade the consignor of the benefits of packings. Profiting by his experience and the fruit of his laboratory tests, he will assist in finding effective and cheap packings.

15. The frequency of manipulations has the determining effect on the packing requirements, and these manipulations tend to become more numerous in the case of railway transport (apart from the door to door technique) than in the case of road transport, so that the railway is in a weaker position than its competitors. Under these conditions, the railway should endeavour to let the consignor share in the benefits obtained from the use of efficient packings by an adequate tariff policy.

# SECTION IV. — General.

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QUESTION III.

## Economic aspects of :

a) discontinuing service on old railway lines;

b) construction of new railway lines;

with regard to the possibility of handling transport with other means.

### SPECIAL REPORT,

by Arne Sjöberg, M. A.,

Chief Research Economist, Swedish State Railways.

### I. INTRODUCTION.

The question of discontinuing service on old railway lines and construction of new railway lines is a part of the more general problem of keeping railway facilities economically adapted to changes in the scope and nature of the demand for railway transportation services.

The question may also be put in another form : Which is the economically proper place of railway service in the general transportation organization of a certain economic region ?

The object of the present special report is to summarize the two following reports relative to the question under discussion :

Report (Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and Overseas Territories, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Turkey and Yugoslavia), by G. Moulart (see *Bulletin* for March 1952, p. 147).

Report (America [North and South], Australia [Commonwealth of], Burma, China, Ceylon, Denmark, Egypt, Finland, India, Irak, Iran, Irish Free State, New Zealand, Norway, Pakistan, South Africa, Sudan, Sweden, United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by Arne Sjöberg (see *Bulletins* for March, p. 201, and April 1952, p. 235).

At the Rome Congress in 1950, the International Railway Congress Association dealt with a subject (1) similar to the one now under consideration. The economic importance of the adaptation measures of the railway enterprises to changing economic conditions and the great interest shown at the Rome Congress for these questions caused the Permanent Commission of the Association to take up for discussion once more, now in a broader connexion and in a more general way than before, the ques-

(1) Special Report by Mr. N. Laloni (*Bulletin* for October 1950, p. 2119).

tion of discontinuing existing railway service and establishing new railway service.

The reports now prepared by Mr. MOULART and Mr. SJÖBERG, are to a certain extent based on a detailed questionnaire, which was jointly drawn by the reporters and sent to all member Administrations of the Association. Only a small minority of the Administrations, however, were for various reasons able to supply answers of real interest for the question under study.

The summaries (part III) of the special report have been prepared in cooperation by Mr. MOULART and the special reporter.

## II. A GENERAL DISCUSSION OF THE QUESTION UNDER STUDY.

### A) General.

1. — The structure of the demand for transportation has radically changed in relation to the days when the railway systems in most countries got the structure as to number, course, and configuration of lines that they still have in the main. New means of transportation : automobiles, pipelines, electric power transmission, etc., have come into existence which, besides fulfilling new requirements, also have taken over transport work previously handled by the railways. Important changes have also occurred in the technical and economic structure and in the geographic distribution of production, etc. All these structural changes in economic life make a general supervision and adaptation of the various elements of the business policy of railways necessary, e.g. policy on the closing down or on the construction of lines, stations, and other facilities, or on rates and methods of production, etc.

2. — As concerns the general layout of a railway system, the aim must now be to establish the railway system as a part of the totally required traffic routes of a region constituting an economic unit. The regions concerned may be of various sizes e. g. the transport routes within a city, or the routes within the influence area of a larger agglomeration, within a large geographic region, or within a whole country. With respect to countries, this total planning of the traffic net will be applicable principally for undeveloped ones. But in countries with well developed economic life and railway system it may also be advantageous to adopt this aspect of planning traffic routes in their entirety with a view to finding out what is wrong with the existing net and how it could suitably be improved by constructing new lines or adding to the capacity of or closing down existing ones.

3. — The structural changes mentioned above which have occurred in the demand for transport services and in transport technology necessitate various adaptation measures respecting the number of lines, stations, etc., in the railway network, if the aim is to bring about as rational a transport system as possible.

As regards regions with not too dense traffic, the transport requirements can probably be met in the best and cheapest way by a relatively wide-meshed network of railways, maintained at a comparatively high technical and operating standard. The size of the mesh of this network will be dependent, among other things, on the proportions of local, regional, and interregional traffic, and on the extent to which it is necessary or profitable to retain local traffic in the network. From the economic point of view this local traffic should mainly consist of road transport, which serves at the same time as a means of collection and dispersal for the railways and which implements the railway network.

Due to the more efficient collection and dispersal of traffic to and from railway stations that have now been effected with the advent of road traffic, the economically optimal distance between railway stations has usually increased to a high degree. This has been manifested in a more marked concentration of traffic to a smaller number of stations.

In some cases an adaptation of the railway network in above respects to the changed conditions would probably presuppose discontinuing of railway service on certain existing lines or stations, and the rehabilitation and refitting of other lines and stations. In certain cases the establishment of new lines and new stations (for collection or dispersal of traffic) or new switching yards, etc., may be justified. Use of road traffic coordinated with the railways as a supplement to and substitute for rail traffic will generally reduce operating costs for the railways and ensure a higher transport standard for the customers of the railway.

4. — Railways throughout the world have found that road motor traffic in many cases may be an important complement to and substitute for rail service, especially for light traffic on branch lines.

In the main, road motor traffic has been used by the railways for the following categories of transport services of passengers and freight :

*a*) collection and delivery service;

*b*) interterminal transfer;

*c*) substitution for line haul rail services on shorter hauls from certain larger stations or centers (railheads);

*d*) substitution for other line haul rail service.

The experiences of railways show that if they are to provide an efficient over-all transportation service they must have the possibility of using buses and trucks either in a coordinated railroad service or solely as a road service. Through such coordinated and substitute road services important economic advantages can be obtained.

For both passenger and freight traffics, most railways are engaged directly or indirectly in road motor operations as feeders or substitutes to rail services.

5. — The problem of establishing an efficient transportation system in a region or in a country is not one of choosing between different individual means of transport, but rather of ensuring, through a flexible combination of different transportation means and facilities, the most efficient transportation service under different circumstances at the lowest possible total real cost to the community. The achievement of such an efficient transportation system is complicated by the fact that in most countries the transportation industry consists of a large number of more or less independent, specialized single-type enterprises, using only one type of transport : rail, road, water, etc., and that governments seldom permit multiple-type transportation enterprises, using all available types of transports, to operate. It is a general experience that the same degree of efficiency and economy of service cannot be obtained through the arrangement of joint service by separate and competing types of transport enterprises. To establish an efficient transportation system, it therefore seems appropriate that the present mode of transportation by specialized enterprises for rail, road, water, air, etc., should be abandoned and replaced by transportation enterprises with access to and using different available technical transport means (transportation companies).

6. — The development of a transport policy aiming at an efficient transportation system, including among other things coordination of the various types of transport, maximum efficiency in organization and operation of each individual enterprise, will be considerably less difficult in undeveloped areas or countries, where one can start building up the system from the beginning, than in older, more highly developed areas or countries where vested interests in communities, investors, government agencies, etc., try to maintain the status quo.

### B) Discontinuing of railway service on old railway lines.

7. — In large railway systems, different

lines and different services will show varying degrees of profitability and will be unable to contribute at a uniform rate to the common and constant expenses of the railway enterprise. It is generally not possible in such systems to avoid the provision of some services which are unprofitable even perhaps in the sense that they do not support their own marginal costs.

The light traffic lines of the railways generally constitute a substantial economic burden both to the railways and to the community. Hence rationalization of the operation of these lines is a matter of some urgency, either within the existing framework of operations or in the form of a complete or partial change over to road traffic when the latter proves less costly and capable of providing the same standard of transport services for the population along the lines in question.

Because of the great number of different factors influencing the profitability of an existing railway service it is generally not possible to give a definite volume of traffic below which the operation of an existing railway service is not profitable. Each individual case of continued operation of railway service must therefore as a rule be investigated and dealt with on its own merits.

The basis for determining whether or not a certain measure, the closing down of a light traffic line or the substitution of road service for rail service, is profitable is a comparison of the expected annual total net-revenues of the railway enterprise in the two alternative situations: the measure in question is executed respectively not executed. A certain measure is profitable for the enterprise as a whole if there is an increase of the total net-revenues of the enterprise, caused by the measure in question.

8. — It is primarily road competition that in all countries has reduced traffic on certain railway lines, especially branch lines, to such an extent as to necessitate total or partial discontinuing of railway service. But road motor transport has not had this negative significance alone; in all countries it has come into use as an important supplement to and substitute for railway operations.

The railways' use of motor traffic as an instrument for rationalizing railway operations has often been delayed or rendered impossible, however, by existing laws making it difficult for them or prohibiting them to acquire licences for the use of buses, trucks, etc. Moreover, railways have often been compelled for social or other reasons to forego such measures as might have been desirable from the standpoint of business economy.

9. — The various measures that might come into question when a railway line has lost all or part of its importance, yet still must face a certain demand and therefore take into account the possibilities of handling transport assignments by road motor traffic or other means of transport, are as follows :

1) total and definitive closing down;

2) partial closing down :

*a*) with respect to certain types of traffic;

*b*) with respect to a certain time period;

*c*) with respect to certain facilities of a line.

In certain cases various combinations of the above measures may come into question.

Partial closing down with respect to certain types of traffic may involve the withdrawal of all passenger or all freight traffic, or the transference e.g. of local passenger or freight traffic to road motor traffic.

Partial closing down with respect to a certain period of time may involve the total withdrawal of all traffic during certain periods when the demand either abates or disappears on a seasonal basis or due to slumps. It may also involve retention

of freight traffic but temporary suspension of passenger traffic.

Partial closing down with respect to certain facilities may involve, for instance, the closing of certain stations and the concentration of traffic to a few centres of distribution or collection by road motor traffic. It may also imply the withdrawal of traffic in certain limited areas, e.g., factory or quayside tracks belonging to a certain line.

As long as a railway line can be operated with relatively low costs for maintenance and renewals and covers its out-of-pocket cost, the need of closing down may often be not so urgent. At the time, however, when it is necessary to spend maintenance expences in order to secure sufficient traffic safety or when renewal of its tracks is due, the line will usually be closed down.

10. — Generally, permission of the government or a special governmental body is required before a railway can close down any part of its railway system. It is apparently a general rule among railway companies that, before applying to the appropriate governmental authority for permission to close down e.g. a certain branch line which has become unprofitable, they first make every effort to increase the traffic receipts and reduce the working expenses of the branch line.

If the government regulatory body, for political, military, or other reasons, should decide not to allow the closing down of a line, even if such closing down indisputably would prove to be profitable, the deficit on operation of the line must usually be covered by the profits on other lines. This naturally implies that higher rates and fares than would otherwise be necessary must be paid by the users of other parts of the system. With regard to public owned railways working with a deficit for the whole system, the public authorities as proprietor of the system, must cover the deficit out of the general revenue from taxes, etc.

Considerations with no bearing upon business economy may thus, through governmental intervention, sometimes lead to commitments for the railway enterprise to operate unprofitable branch lines or e.g. to apply economically too high operating standards or too low tariffs on certain lines or branches of traffic. It is a common opinion among railways that in all such cases, railway companies ought to be compensated for losses incurred by such operations that are not consistent with business economy.

11. — The economic policy of a railway enterprise usually aims at covering the costs for the railway system as a whole. The tariffs applied are generally uniform in respect of the entire system; they take no account of differences in transport costs on different lines or during different seasons of the year, etc. Hence a substantial economic equalization in tariffs occurs between different lines and different time periods. As regards different lines of a railway system this equalization in tariffs means that losses on light traffic lines are compensated by profits on other lines. With these uniform tariffs valid for the whole system it is not always possible for lines of lower traffic density, and especially for new branch lines, to pay their way.

The prospects of improving the economy of a light traffic line through special measures on the tariff side are, as a rule, fairly remote. A general increase in tariffs is seldom possible since railways are usually bound to apply uniform tariffs throughout the railway system. In certain cases it should be possible, with flexible selling methods and a differentiated tariff policy with lower rates (agreed charges, quantity rebates, etc.), to provide the impetus for a larger traffic volume, which might improve the economy of the line. Generally, it would be easier to avoid deficit on operation of light traffic lines if railways were authorized to diverge from the general rule of applying uniform tariffs on all lines of

the network and if, when economically possible and necessary, they thus could apply higher rates on light traffic lines.

Operating methods may vary on these light traffic lines according to the nature and extent of the traffic to be carried, and may generally be said to be simpler than on the main lines. The general policy of railway managements in respect of operation of light traffic lines is to seek to reduce operating expenses as much as possible and to create for their light traffic lines an organization particularly suited to the nature of such lines, above all to the volume of traffic and to the particular requirements of the railway customers.

### C) Construction of new railway lines, etc.

12. — For an economically rational planning of a new transport line it does not suffice merely to consider a purely rail or purely road alternative; various combinations of rail-road alternatives must also be investigated. According to the special conditions in each individual instance, it may thus be necessary to investigate rail alternatives, ranging from full passenger and freight traffic to and from a number of stations, to traffic on factory sidings alone under simple forms. For the same reason the road alternative for its part may vary between full passenger and freight traffic on a ramified network, and freight or passenger traffic on a single route. Lastly, various combinations of the aforementioned rail and road alternatives may come into question.

13. — Construction of new railway lines has risen considerably during the last years, especially in new countries in Africa and Asia. But also in some more industrialized countries in Europe and in America new lines have been built to meet expanding industrial needs and as connecting links and complement lines to existing railway systems. (But in the latter countries, old lines have generally been abandoned on a larger scale than new ones have been constructed.)

14. — Nowadays, it is usually the need of freight transports that necessitates the construction of new railway lines. Since a number of different factors influence the profitability of a railway project, it is usually impossible to lay down any generally valid minimum traffic intensity required if that project is to be profitable. This minimum varies greatly according to the circumstances in each individual case, and as a rule each case must therefore be considered on its own merits. Yet it may be possible, under certain simplified premises, to lay down certain « rules of thumb » as to the minimum traffic density required.

Some railways have made estimates of the probable minimum traffic density under average conditions in their countries that would render a new line profitable. They all stress that such an estimate, by the very nature of the problem, must of necessity be very rough. European experiences indicate that the minimum traffic density for profitability of a new individual railway line must be of the magnitude of 400 000-500 000 tkm per kilometre of line. When it is a question of a feeder line to an existing line or network the profitability of the new line can be obtained by a lesser traffic volume than the one just mentioned. From the nature of the problem it is easily understood that the minimum traffic density for profitability of a new line to be constructed must be considerably higher than the one necessary for maintaining an old line.

In new or insufficiently developed countries, the construction of new railway lines seems economically justified when the traffic density is at least 300 000-400 000 tkm per kilometre of line. If the traffic is less than this, the transport can generally be carried out more economically by road, if roads are available that can carry heavy trucks with trailers. The economic risks involved in railway construction are nowa-

days usually less in new countries than in old ones on account of the generally more rapid economic development in new countries.

15. — The principal determining factors for the profitability of a new railway line are the probable future volume of traffic at various possible tariff levels and the resultant costs of establishing the facilities and operating the traffic, the estimated composition of different commodities carried and the influence of the new line in respect of costs and revenues on the existing railway system.

With a system of tariffs based on the value of commodities carried, the minimum traffic density necessary to attain profitability of a new railway line will therefore have to be greater, if the anticipated traffic consists of low-value commodities, raw materials, etc., than if it is composed of high-value commodities for which higher tariffs can be applied. Furthermore, if higher tariffs can be applied, at least temporarily, on the new line than on the rest of the railway system, the traffic density required for profitability will be correspondingly lower. In general, the possibility of attaining profitable operation of a new line may be said to be the greater, the more differentiated the rates can be that are to be applied for passenger and freight traffic using the new line. Hence the general uniformity of tariffs throughout a railway system, which today is very common with railway enterprises, will often render difficult what would otherwise be a practicable expansion and implementation of the railway system with new lines.

When the new railway line is projected to implement an existing railway system, consideration must also be given to the additional and subtractive revenues and costs that will occur on other lines of the system through the establishment of the line in question.

16. — Building of new facilities nowadays is undertaken by railways for the purpose of expanding or modernizing their plant. Developments in industry, new methods of distribution, and new forms of competition in transportation are bringing new problems in railway operation. Moreover, customers of the railways are demanding higher standard of service than before. All these changes and shifts in the demand for railway transport services, necessitate various adaptation measures in railway operating methods. Such changes in operating methods and facilities have entailed a corresponding need for new facilities and for reconstruction of existing facilities which embraces practically all kinds of fixed property, including double track, revision of alignment, passing sidings, yards, terminals, etc.

*Points suggested for discussion :*

1) The general problem of adaptation of railway facilities to changing economic conditions with special reference to light traffic lines. Experiences regarding the necessity and possibility of such adaptations of railway facilities.

2) What constitutes an efficient national transportation policy ? The responsibility of the government for establishing an efficient national transportation system.

3) Planning of an efficient, adequate, economical and properly integrated national transportation system. The role of railways, road motor traffic, etc., in such a system.

4) In which respects are business-economical adaptation measures most urgent for railways nowadays ? What has been done and what can be done ?

5) Reasons for discontinuing of railway service or closing down of railway facilities.

6) How is the unprofitability of railway facilities determined ? Calculation problems.

7) Unprofitable railway lines, their relative extent in railway systems and their financial burden to the systems.

8) By which measures can the profitability of light traffic lines be improved?

9) Road omnibus service as a substitute for rail passenger service. Operation experiences, passenger preferences, and the possibilities of attaining economies by such substitution.

10) Experiences regarding the organization of railway omnibus service, substituting rail service. Which is the economically best solution and why : Omnibus belonging to the railway, hired omnibus, or contracted omnibus?

11) The fares problem for omnibus service replacing rail service. Bus fares or rail fares?

12) Road truck service as a substitute for rail freight service. Operation experiences, shipper preferences, and the possibilities of attaining economies by such substitution.

13) Experiences regarding the organization of railway truck service. Which is the economically best solution and why : Trucks belonging to the railway, hired trucks, or contracted trucks?

14) The rate problem for truck service replacing rail service. Truck rates or rail rates?

15) Reasons for construction of new railway facilities, lines, etc.

## III. SUMMARIES.

1. — Since the advent of railways, commercial and industrial needs have completely changed. The same applies to means of transport.

On the other hand most railways were built piecemeal under no coherent plan.

It is necessary to reconsider the transport problem for each region, within the framework of a rational plan and taking into account all existing means of transport.

This reconsideration should be conducted with a view to ascertaining the transport facilities that should be suppressed and the new or substitute ones that should be adopted.

Exceptions may be allowed when some given means of transport is more appropriate for certain types of goods owing, for instance, to their nature and delivery delay requirements.

2. — In order to enable the railways to fulfill under the most economical conditions their role of means of transport as a public utility, they should be authorized to use and work in every case the most rational mode of transport (combination between rail, road, etc.) without restrictions or without needing special licenses.

This solution will give to the customers the best guarantee for security, comfort, and adequacy of service, and to the Railways an assurance of maintaining their receipts.

3. — In such a system of public transportation, road transport is in principle used as a means of regional collection and dispersal from and to certain concentration points situated on the most important railway lines.

Owing to these conditions road may be substituted for rail service in such regions.

4. — The closing down of a line or the substitution by railway companies of road service to rail service must generally be authorized by the government.

When the government does not agree to the granting of this authorization for reasons opposed to the economic interests of the railways, these should receive compensation for losses on operation of the line.

5. — Some railway companies consider total or partial suspension of rail service as the principal measure to be taken for deficit lines.

However, the deficit of a line depends on many factors, among them the tariffs applied. It is generally difficult to determine the minimum traffic required to avoid deficit on operation.

Nevertheless, investigations of feeder or local lines made by some companies have

shown that a maximum annual traffic of the magnitude of 250 000 traffic units (1) per kilometre of line can be carried out more economically by road, even on the hypothesis of totally maintaining the existing railway rates.

6. — The experiences of some European railway companies indicate that withdrawal of passenger trains on mixed traffic lines and their replacing by bus service will involve a noticeably higher daily mileage run as compared to the passenger train service.

Nevertheless, the withdrawal of passenger trains brings the greater part of the total saving arising from the closing of the line.

7. — The withdrawal of freight trains and the closing down of the line cannot generally be considered unless the customers have the possibility of loading and unloading their freight at another station — without excessive extending of the haulage distances — or unless the railways can carry out road transport without the additional expenses exceeding the realized economies.

In the latter case, it becomes advisable to use either, on the one hand, large containers, or similar carrying equipment, or on the other hand, wagon-conveying trailers.

It should be pointed out that on mixed traffic lines suspension of freight traffic generally brings only fairly limited savings.

(1) I.e. the sum of passenger-kilometres and ton-kilometres.

8. — The building of new lines is practically no longer justified except in incompletely developed or exploited regions or countries.

It usually arises out of the need for freight transport facilities.

9. — According to estimates made by various railway companies the minimum traffic density justifying the building of a new separate line should amount from 300 000 to 500 000 tkm per annum per kilometre of line.

When it is a question of a new feeder line to an existing line or network, the profitability of the new line can be ensured by a lesser traffic than the one mentioned above.

Smaller traffic volumes can be handled more economically by road, provided roads are available to carry heavy trucks with trailers.

10. — It would be easier to avoid deficit on operation and even to ensure a certain degree of rentability on a new line or on an existing light traffic line if the railway were authorized to diverge from the general rule of applying uniform rates on all the lines of the network. The railway should, therefore, within certain limits, be allowed to charge on these new or light traffic lines higher rates than the ordinary ones.

This solution would, among other things, enable the railway to avoid the closing down of certain deficit lines and would also promote the construction of new lines.

[ 625 .162 & 656 .254 ]

# INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

## ENLARGED MEETING OF THE PERMANENT COMMISSION (STOCKHOLM, 1952,)

## QUESTION I.

**A. — What are the new safety measures taken for level crossing of railway tracks by the road in respect of the density, high tonnage and speed of the road traffic?**

**In particular automatic signalling and closing of level crossings without keepers, worked by the trains themselves.**

**Technical and statistical investigation in order to ascertain the relative safety of :**

**1° level crossings with keepers, with the different devices to announce the arrival of the train to the keepers;**

**2° level crossings without keepers :**

**a) without any self-acting device announcing the arrival of trains;**

**b) with automatic signalling for the road-users;**

**c) with automatic signalling completed by half- or entire gates.**

**B — Cases of level crossing of railway tracks by a road with a railway (urban or suburban) running alongside.**

## SUPPLEMENT TO REPORT, (*)

by A. DONIZEAU,

Chef du Service de la Voie et des Bâtiments de la Région Ouest de la Société Nationale des Chemins de fer français.

*Austrian Federal Railways;*
*Mozambique Railways,*
*Czechoslovakian Railways.*

For various reasons (sent in late, delays in translation, etc.), it was impossible to include in our report all or part of the replies received from the above Administrations, so the present supplement was prepared in order to give the main details they contained.

These replies do not in practice entail

(1) See *Bulletin of the International Railway Congress Association* for May 1952, p. 343.

any modifications to the conclusions developed in the report.

Only the Czechoslovakian Railways are considering making use of the traffic moment to decide how level crossings on secondary lines are to be operated. The two other Administrations consider this factor is insufficient: in particular, the Austrian Federal Railways insist on the importance of the factor « the respective speeds of the road and railway traffics ».

The level crossings of these Administrations are, like everywhere else, subjected to legal requirements adapted to the operating requirements of the lines and the character of the level crossings.

**Level crossings with keepers.**

On important roads, road traffic is warned at a distance that a level crossing is coming by the notice « gates ». In Austria, this signal is completed by signs showing the distance to the level crossing (article 46 of the Geneva Convention). The visibility of the gates when closed has been improved by suitable painting and the use of reflectors (scotchlite, coloured glass reflectors, catseyes, and by electric lightings. The Austrian Federal Railways are thinking of using coloured light signals when the gates are closed. In certain cases, the Czechoslovakian Railways have duplicated the acoustic signals giving warning of the closing of the gates by winking lights at level crossings where the gates are distant-operated and the traffic is heavy, as well as at certain level crossings where the visibility is poor. In addition, they are taking steps to make level crossings visible at a distance equal to the braking distance which is fixed at 100, 70 or 50 m (109, 76 or 55 yards) according to the category of road.

*Methods of advising the keepers.*

*Austrian Federal Railways.*

The keepers have the train timetables; they close the gates at level crossings operated on the open system 3 minutes before a train is due (5 minutes in the case of level crossings operated from a distance and 10 when the level crossing is used by cattle). In addition, the keeper can be advised by the neighbouring stations or signal boxes. There is no automatic warning. Nor are there any signals interlocked with the gates to protect the level crossings.

*Mozambique Railways.*

At the most important level crossings, the keepers are advised by telephone.

There are also a few automatic warnings given by means of a track circuit.

*Czechoslovakian Railways.*

The keepers have the timetables. In addition, they are warned of the approach of trains by bells and are advised if the delay exceeds 10 min. There are no automatic warnings.

A very few especially dangerous level crossings are protected by signals interlocked with the gates.

**Level crossings without keepers, with no warning of the approach of trains.**

The distant signal used on the road in the case of level crossings without keepers is the sign « locomotive » on a triangular plate. The signal used at the crossing itself is the St. Andrews Cross.

As regards the visibility required if the crossing is to be operated without keeper, the regulations were not gone into. In actual fact, the Austrian Federal Railways and Czechoslovakian Railways appear to do everything possible to make the crossing clearly visible from the road over the whole of the braking distance. This braking distance is however very different in the two countries, as the Austrian Railways indicated a distance of 20 m (21 yards) which may even be reduced to 15 m (16 yards), and the Czechoslovakian Railways a distance of 100, 70 or 50 m according to the category of road.

The Czechoslovakian Railways make use of the traffic moment when taking into account the characteristics which, on secondary lines, can lead to the adoption of the regime without keeper without signals.

The whistle is only used when the visibility is poor on the Austrian Federal Railways and the Czechoslovakian Railways. The whistle is used in all cases on the Mozambique Railways.

The Czechoslovakian Railways are improving their locomotive headlights to make them more effective.

**Level crossings without keepers, with automatic warning of the approach of trains.**

*Installations in service :*

Austria : 42.

Czechoslovakia : A few installations under trial.

Mozambique Railways : Have 4 automatic warning installations, but these appear to be in use at level crossings at which there are keepers but no gates, so that they do not come into the category of installations with which we are now concerned.

*Opinions of the Administrations on the programmes to be carried out.*

a) *Need for a line clear indication.*

The Austrian Federal Railways consider it necessary to have a light showing line clear. They consider this is a check on the working of the equipment.

The Czechoslovakian Railways do not appear to stipulate the use of such a light.

b) *Actual meaning to be given to the light.*

This point was not gone into in the replies.

c) *Aspect to be given to the light. Duplicating it by an audible signal.*

« DANGER » is indicated by a winking red light. The light winks 80 to 90 times a minute. The line clear light used by the Austrian Federal Railways winks at a much slower rate : 45 times a minute. This railway does not duplicate the lights by an audible signal.

d) *Addition of automatic gates or half-gates.*

The Austrian Federal Railways are considering the use of automatic gates in the future. The Czechoslovakian Railways likewise.

In the case of double track lines, the Czechoslovakian Railways consider that the use of the automatic signals in any case necessitates very good discipline amongst road users. Where such discipline exists, the case of double track lines is similar to that of single track crossings, and where it does not exist the system is dangerous even in the case of single track crossings.

Austria moreover considers that when a lot of cattle use the crossing, the only safe method is the level crossing with keeper and gates.

e) *Length of the warning.*

The Austrian Federal Railways did not give any figure. They have fixed at only 20″ the interval between showing the danger light and the closing of the automatic gates, when these are used.

The Czechoslovakian Railways seem to have adopted 30″ with an additional 20″ when there are automatic gates (15″ : delay in closing the gates with 5″ delay by the keeper).

f) The two Administrations stipulate that the danger signal shall go off as soon as the train has passed. Only the Czechoslovakian Railways consider it useful to have a constant period of warning given by the danger signal.

g) *Breakdowns.*

The Austrian Federal Railways consider that when a line clear indication is given, it is at once apparent if anything goes

wrong with the installation. This implies that there is no doubt on the part of the road user as to whether the level crossing is or is not equipped with automatic signals.

In Czechoslovakia, a breakdown is indicated by a breakdown notice with the indication « STOP ».

None of the Administrations stipulate that level crossings without keepers with automatic signalling shall be protected by signals.

**Statistical results. — Tendencies of the Administrations.**

STATISTICS OF ACCIDENTS

The Austrian Federal Railways gave very complete statistics of accidents occurring during the last five years. The average number of persons killed during this period is 12 for about 11 340 level crossings, 3 200 of which have keepers, 8 100 of which have no keepers or automatic signalling, and 42 have no keepers but are equipped with automatic signalling. It is remarkable that the statistics do not give any particulars about casualties (killed or wounded) for the 42 level crossings without gates, equipped wich automatic signals.

In the case of level crossings without keepers without signalling, 0.086 persons were killed per 100 level crossings per annum.

The same statistics show the great number of collisions with the gates in the case of level crossings with keepers. In this case, the average number of persons killed during the five years was 0.145 per 100 level crossings per annum.

Mistakes on the part of the keeper were at the bottom of 25 % of the collisions occurring between road vehicles and trains at level crossings with keepers.

The Czechoslovakian Railways keep numerical statistics in a different form to those given in the table attached to the questionnaire. They confirm that the number of accidents due to collisions with the gates at crossings is very great and state that in the case of level crossings with keepers the proportion of accidents for which the railway is responsible is 1 32th.

The above statistical results call for the same comments as those given in the report (difficulties due to the fact that the total figures given are not always comparable; uncertainty about the comparison because the statistics do not allow to take into account the average risks proper to the different categories considered).

As far as tendencies are concerned, the Administrations consulted, especially the Czechoslovakian Railways do not yet appear to have come to any definite conclusions, at least in the case of replacing keepers by the regime without keepers with automatic signalling. It should however be noted that they stress the following points :

1) necessity for strict discipline amongst road users (recommended by the Czechoslovakian Railways) ;

2) the special danger in the case of cattle (stressed by the Austrian Federal Railways) ;

3) the advantages of the regime without keeper with automatic signalling from the point of view of the free flow of road traffic (Austrian Federal Railways).

These points were already raised in the report. In particular, we stated in our summaries that the question of cattle should be the subject of precise regulations strictly applied, in those countries where this is not already the case. It would in fact be quite irregular that owing to the fact that certain road traffic cannot be sufficiently controlled, the use of the regime without keeper should be systematically shelved, as its adoption in suitable cases is certainly a source of economy.

For the rest, the replies given by the three Administrations covered by the present supplement do not make it necessary to modify the summaries of the first report.